CS626: Speech, NLP and the Web

Introduction

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NLP-ML

NLP is heavily ML Driven: WHY?

- Borrowing Shakespeare: “NLP Thy Name is Ambiguity!!”

- At every stage of processing starting from **utterance sound** to **discourse** there are multiple options available

- ML works as classifier to choose the correct option

A look at ACL 2020 accepted papers

- **A Call for More Rigor in Unsupervised Cross-lingual Learning**
  Mikel Artetxe, Sebastian Ruder, Dani Yogatama, Gorka Labaka and Eneko Agirre
- **A Comprehensive Analysis of Preprocessing for Word Representation Learning in Affective Tasks**
  Nastaran Babanejad, Ameeta Agrawal, Aijun An and Manos Papagelis
- **A Contextual Hierarchical Attention Network with Adaptive Objective for Dialogue State Tracking**
  Yong Shan, Zekang Li, Jinchao Zhang, Fandong Meng, Yang Feng, Cheng Niu and Jie Zhou
- **A Generative Model for Joint Natural Language Understanding and Generation**

ML also needs NLP: WHY?

- ML looking for interesting and challenging problems
- Deep questions starting from **Child Language Acquisition** to **Aphasia** (language impairment)
- NLP a test bed for ML ideas

- Decision making under uncertainty

A look at ICML 2020 papers

- ***On Variational Learning of Controllable Representations for Text without Supervision:*** Peng Xu, Jackie Chi Kit Cheung, Yanshuai Cao
- ***Recurrent Hierarchical Topic-Guided RNN for Language Generation:*** Dandan Guo, Bo Chen, Ruiying Lu, Mingyuan Zhou
- ***The Effect of Natural Distribution Shift on Question Answering Models:*** John Miller, Karl Krauth, Benjamin Recht, Ludwig Schmidt

- ***Non-Autoregressive Neural Text-to-Speech:*** Kainan Peng, Wei Ping, Zhao Song, Kexin Zhao

Nature of ML

A Perspective on Machine Learning

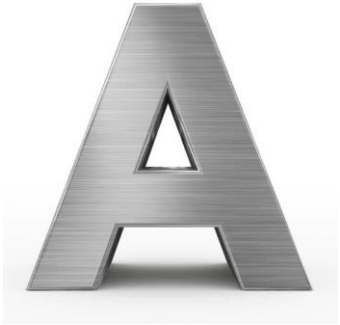
Table Lookup

Rules

Statistical ML: SVM, LR, etc.

Deep Neural Net

Table Look up



How many to store?

What is the essential “Aness”?

Rules

- Letter ‘A’ is formed from **two inclined straight lines, meeting at a point** with a **horizontal straight line cutting across**
  - Exception: need not be straight lines; need not meet; the 3rd line need not be horizontal, need not be straight

- Leads to false negative- ERROR OF OMMISSION

From Exact to Approximate, 100% to X% (X< 100)

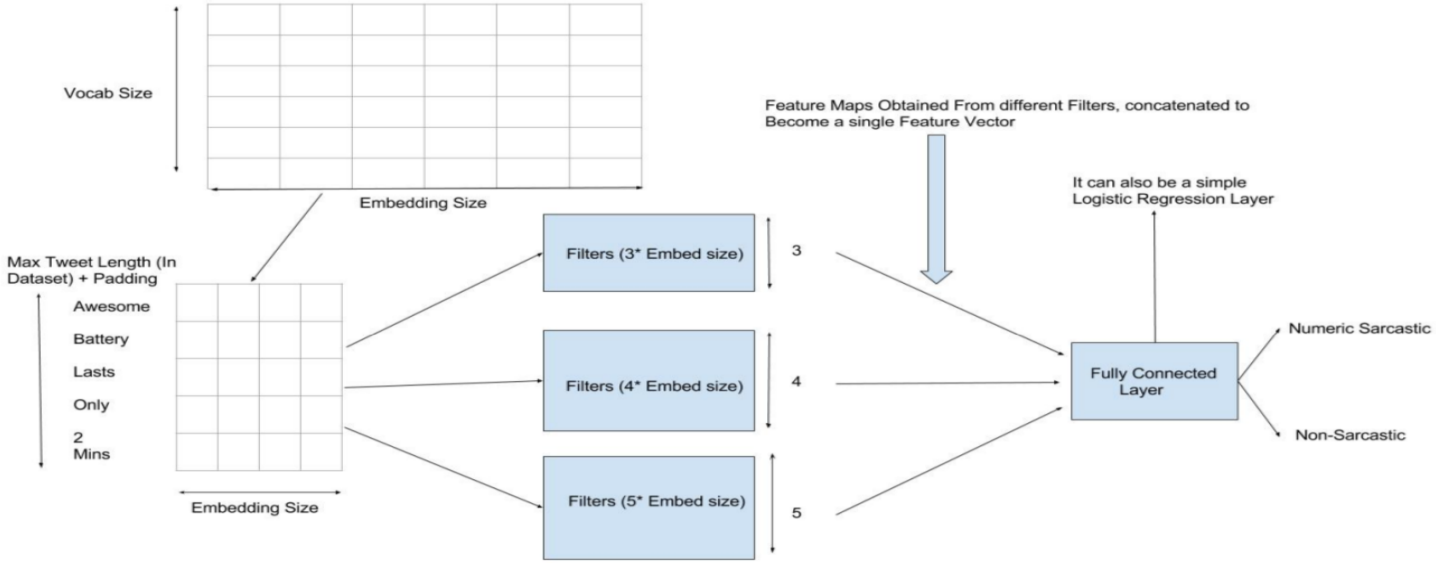
- Very, very, hard to eliminate completely-false positives and false negatives
- Even humans cannot achieve that performance in most complex tasks
- Decision making under uncertainty, under error bound

LEARN from Data with Probability Based Scoring

- **Data + Classifier > Human decision maker !!**
- With LOTs of data, learn with
  - High precision (small possibility of error of commission)
  - High recall (small possibility of error of omission)
- But depends on human engineered features, i.e., capturing essential properties

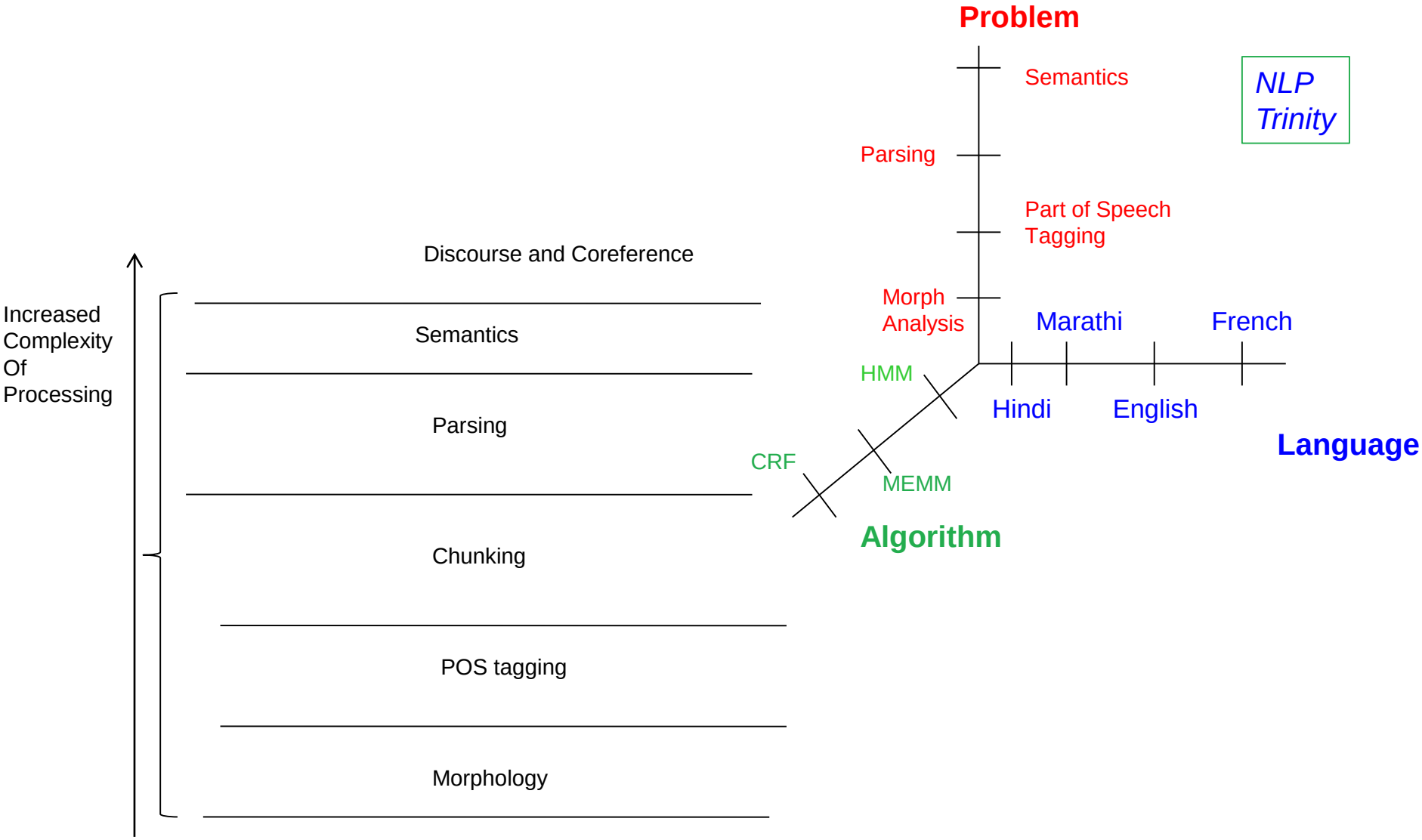
Reduce human dependency: DEEP LEARN

- End to end systems; essential properties learnt at intermediate layers



Ambiguity

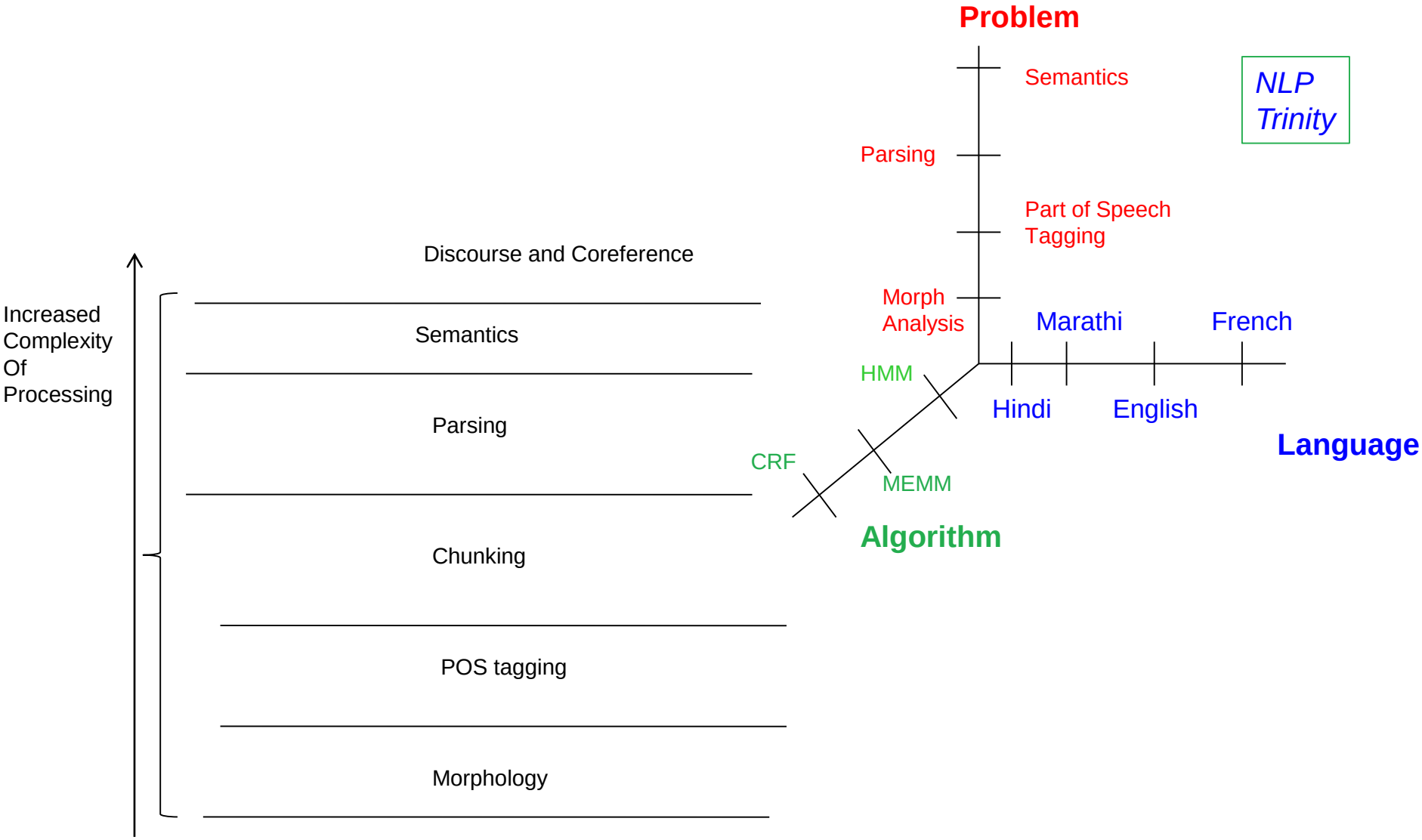
NLP: a useful view



Example-1

- “Pilot cancels flight from Congress”- Times of India, 11 August 2020
  - Proper Noun (Named Entity) - Common Noun Ambiguity
    - Clue: ‘Congress’
    - Learn from data
    - Normally flights are to and from places
    - ‘Congress’ not a place
    - ‘Pilots’ manoeuvre flights
    - This is ‘flight’ is not normal flight

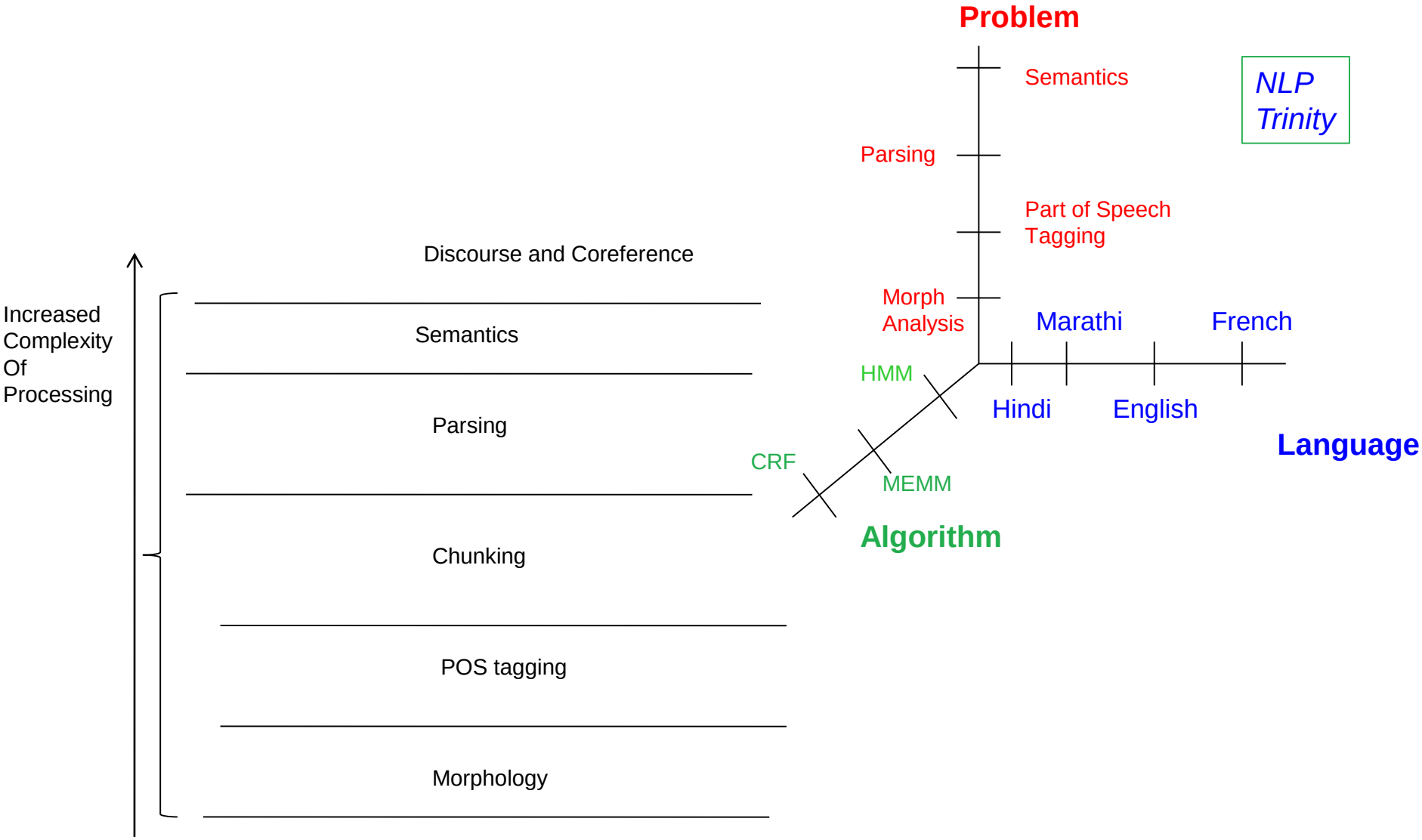
NLP: a useful view



Example-2

- “No dogs please”
- Grouping ambiguity
  - ‘No dogs’→ dogs not allowed
  - ‘No, dogs please’→ dogs definitely are allowed
  - ‘please’: give joy→
    - There are no dogs who give joy
    - No, dogs definitely give joy

NLP: a useful view



Example-2 cntd.

- S: (n) **dog**, domestic dog, Canis familiaris (a member of the genus Canis *"the dog barked all night"*
- S: (n) **dog** (informal term for a man) *"you lucky dog"*
- S: (n) frank, frankfurter, hotdog, hot dog, **dog**, wiener, wienerwurst, weenie (a smooth-textured sausage of minced beef or pork usually smoked; often served on a bread roll)
- S: (n) pawl, detent, click, **dog** (a hinged catch that fits into a notch of a ratchet to move a wheel forward or prevent it from moving backward)
- S: (n) andiron, firedog, **dog**, dog-iron (metal supports for logs in a fireplace) *"the andirons were too hot to touch"*

Example-2: Combinatorial Explosion possibility

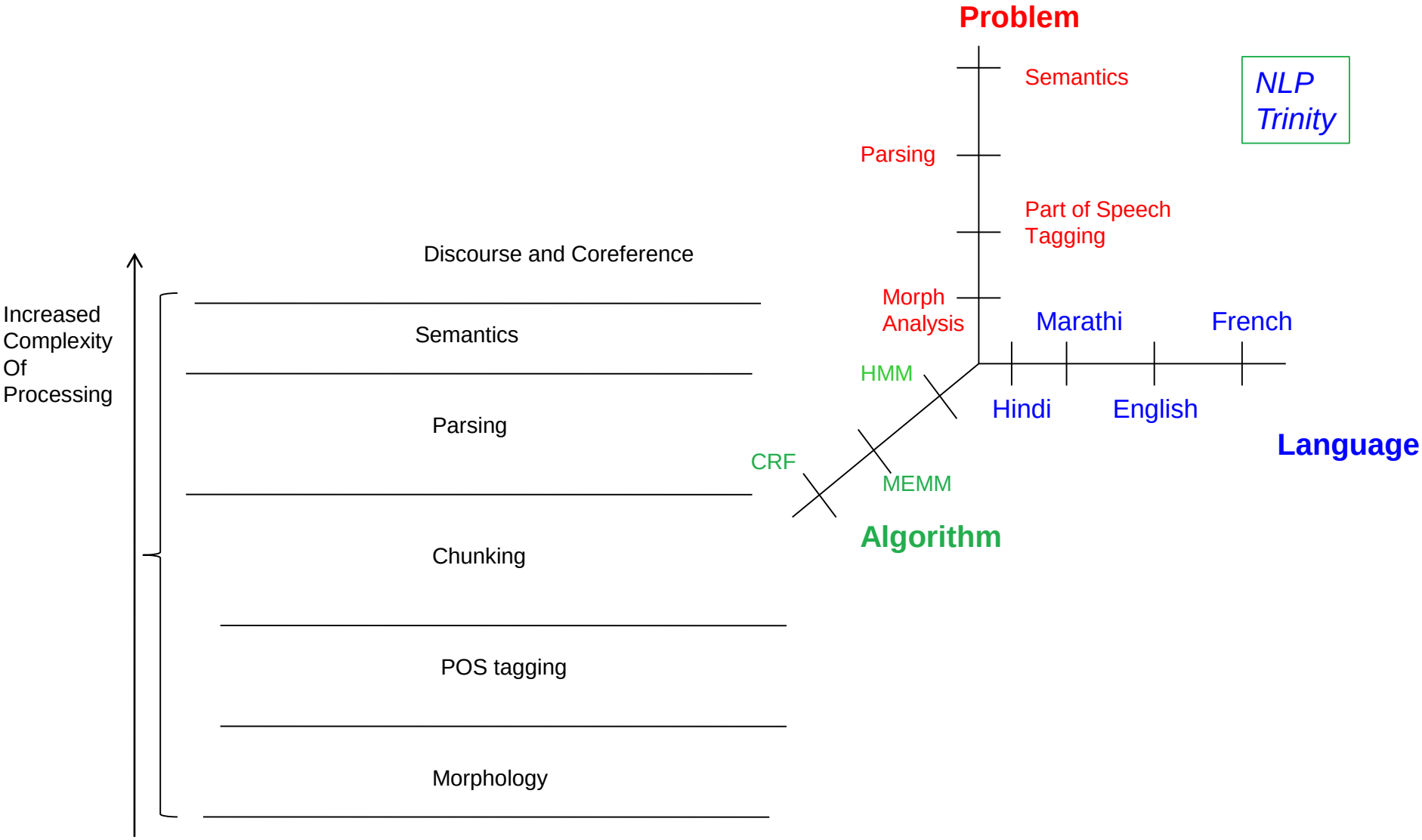
- Grouping ambiguity
- Word sense ambiguity
- ‘no dogs please’: 3 groupings
- ‘dogs’→ 7 noun meanings, 1 verb meaning
- ‘please’→ 3 verb meanings, 1 adverb meaning
- 63 possible meanings !!!
- *Very characteristic of NLP, e.g., MT*
- NP hardness proved in 1992

Example-3

- “Flying planes can be dangerous”

- Semantic Role Ambiguity
  - ‘flying planes ARE dangerous’→ no ambiguity
    - Planes: ‘subject’
  - ‘flying planes IS dangerous’→ no ambiguity
    - Planes: ‘object’

NLP: a useful view



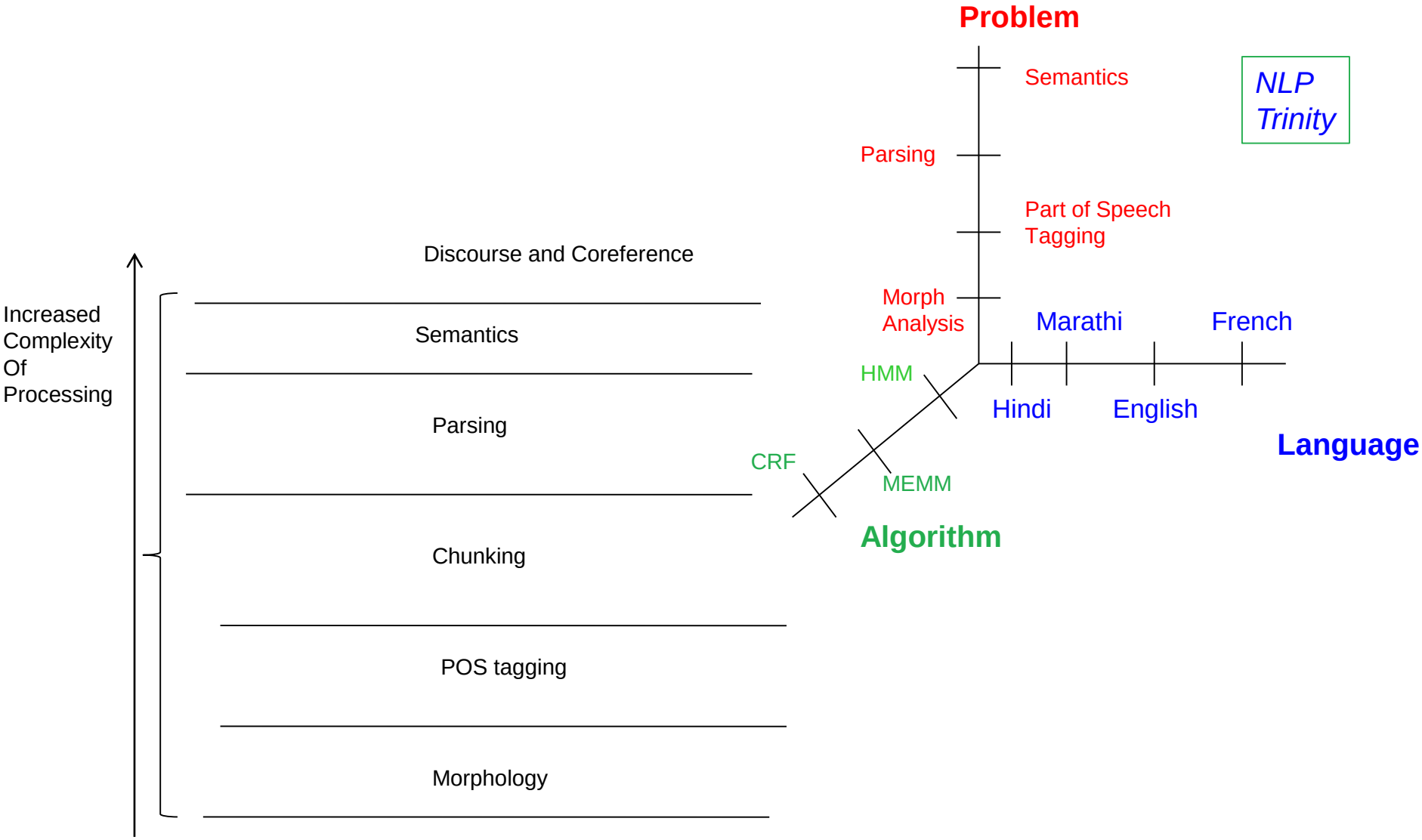
Example-4: Pragmatic Ambiguity

Pax: ***thank you for sending me to Delhi and my luggage to Mumbai ! Brilliant service!!!***

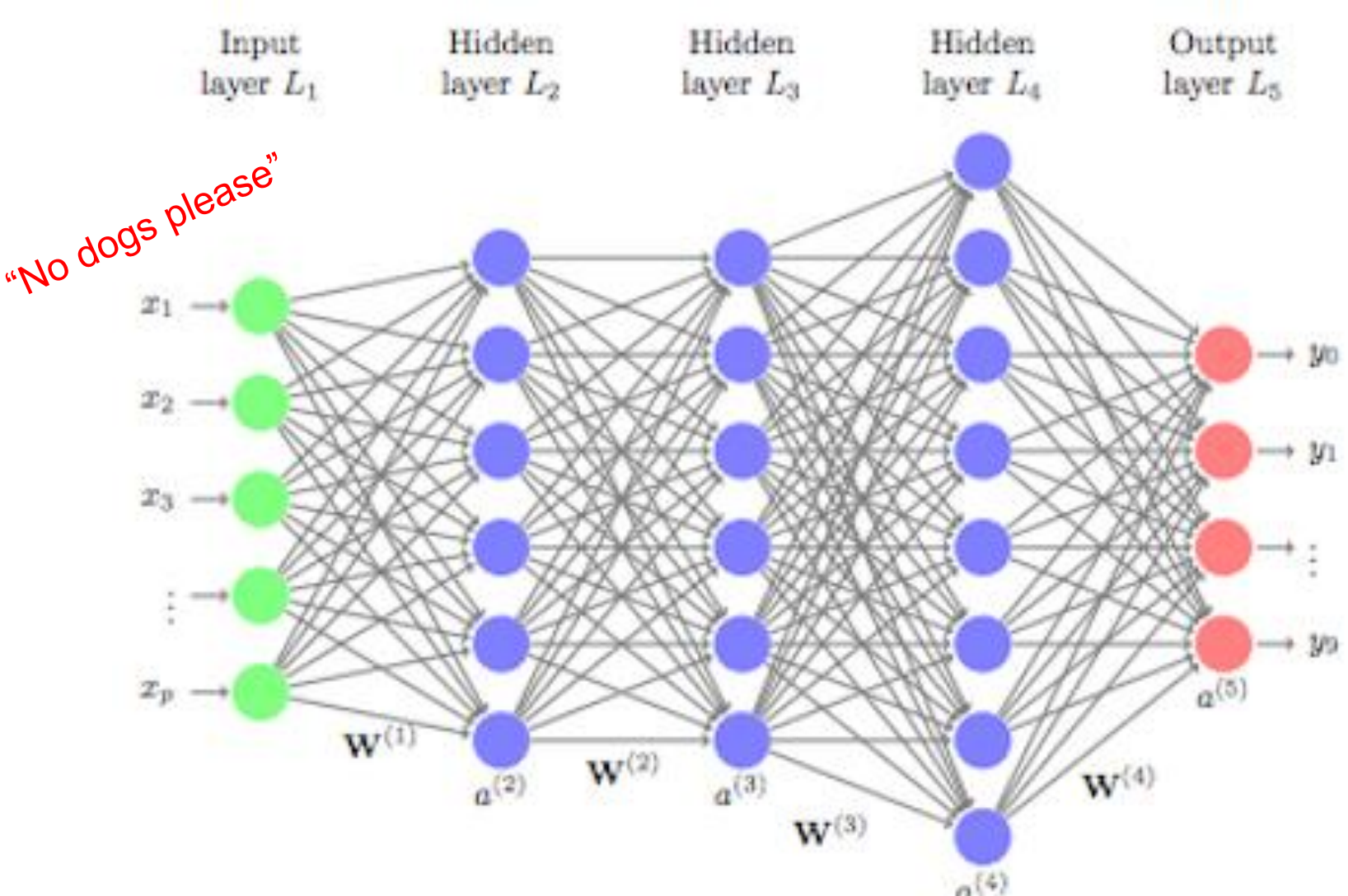
Chatbot: ***Thanks for the appreciation*** 🙏

sarcasm

NLP: a useful view



Deep Neural Nets and Ambiguity



Course: Basic Info

- Slot 1: Monday 8.30, Tuesday 9.30 and Thursday 10.30
- TAs: Diptesh Kanojia, Jyotsna Khatri, Satyam Behera; also Assistance by Prashaant Sharma
- http://www.cfilt.iitb.ac.in/cs626
- Channels of communication: Moodle, MS Teams, Whatsapp, Course Website

Play recording

- NLP course information
- CFILT Lab information

URLS

http://www.cse.iitb.ac.in/~pb

http://www.cfilt.iitb.ac.in

Important Message

"NLP is a task in Trade Off"

e.g., Not too much of Information

(beware of *'ambiguity insertion' and 'Topic Drift'*),

not too little

(beware of 'sparsity') !!

“The middle path is the golden one”- Buddha

Thank You